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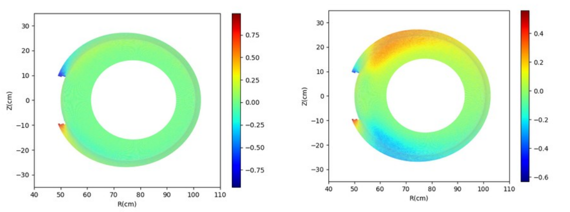
Implementation of 3D Monte-Carlo simulations in the inboard limited Aditya-U scrape-off layer Plasma

Arzoo Malwal[1,3], Bibhu prasad Sahoo[2], Devendra Sharma[1,3]
[1] *Institute for Plasma Research, Bhat, Gandhinagar, Gujarat 382428,*
[2] *Bhubaneswar College of Engineering, Khajuria, Jankia, Khurda, Odisha*
[3] *Homi Bhabha National Institute, Training School Complex, Anushakti nagar, Mumbai 400094, India*
e-mail: arzoomalwal@gmail.com

Transport of the hot fusion plasma in the open field line region of a scrape-off layer (SOL) is a key factor to be understood and controlled for the stable operation of a magnetic confinement fusion device like a tokamak or stellarator. With localized structures of plasma targets such as limiter or divertor and shaped plasma-field equilibrium, determination of the SOL plasma transport characteristics is essentially a three-dimensional problem, to be solved on the magnetic flux surface aligned coordinates. Recent 3D simulation-based SOL plasma transport studies of Aditya and Aditya-Upgrade tokamak relevant MHD equilibria had indicated relaxation of the recycling process for maintaining equivalent upstream plasma conditions for an outboard limited plasma [1]. The 3D coupled plasma-neutral Monte-Carlo simulation code EMC3-EIRENE [2] is being used to study the plasma transport in the SOL. Relatively larger radial diffusive flux in the regions of longer connection lengths on the last closed flux surface was also identified in Aditya which in large reactor grade devices are responsible for extensive off-divertor recycling [3].

First 3D simulations of inboard limited Aditya-Upgrade SOL plasma, relevant to certain recent observations on the device [4], are now performed and reported in this work.

The 3D plasma flow characteristics show a set of mutually counter-propagating sonic flows to the toroidally inboard targets in the near and far-SOL regions of the plasma, respectively. The weaker near-SOL flows are identified as originating from the trapping of the radially diffused plasma because of the internal curvature of the newly installed inboard belt limiter. For larger anomalous radial diffusivity and higher toroidal magnetic field, the near-SOL flows are also observed to potentially induce an up-down symmetric plasma rotation in the close field line region of the edge plasma. The first 3D simulation setup and primary analysis of the simulation results will be presented.



Mach Number Profile for low Magnetic field   Mach Number Profile for high Magnetic field

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